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A new disruptive green & safe technology in Biocide Water Treatment

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Claude DIGIARO & Jessyka FORTIN

amoéba

Content

1. A new patented biopesticide for water treatment
2. Amoéba's disruptive technology
3. *Willaertia magna C2c Maky* application
4. Efficacy of the biopesticide program
5. Conclusions

A new biopesticide for industrial water treatment

- Amoéba has developped a unique patented biopesticide effective to kill waterborne bacteria, including *Legionella pneumophila*
- It is the first biopesticide to control microbial slime in industrial cooling towers
- It is classified as 'non-hazardous for human health & the environment*'

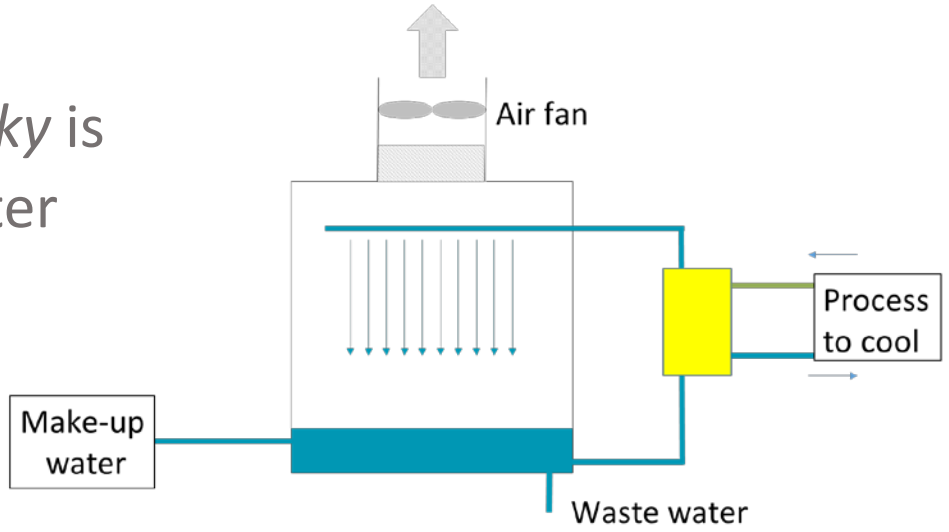
An alternative solution

to chemical biocides used in cooling circuits

**In accordance Globally Harmonized System of Classification and Labelling of Chemicals*

Willaertia magna C2c Maky application

- *Willaertia magna C2c Maky* is injected in the make up water



Schematic example of a cooling tower

- Routine concentration ranging from 7 600 to 380 000 cells/ gallons

- Regular dosage of *Wm's* product used:

  10 to 65 ppm for the 3% conc. (0.85 to 8.5 oz per 1,000 US gallons)

  2 to 20 ppm for 10% conc. (0.27 to 2.6 oz/1,000 US gallons)

  1 to 6.5 ppm for 30% conc. (0.1 to 0.85 oz /1,000 US gallons)

A new biological biocide for industrial water treatment

The only biopesticide for industrial water treatment without any ‘class of hazards to human health and the environment’*

Amoéba’s biopesticide

chemical biocides

*In accordance with regulation (EC) No 1272/2008 on classification and labeling of substances and mixtures

Amoébas’ disruptive technology

Amoéba's disruptive technology

- Based on a 100% natural microorganism:

  Willaertia magna C2c Maky

- It is a non-genetically modified microorganism isolated from the thermal baths of Aix-les-Bains (France).
- It belongs to the protozoan order, among eukaryotic unicellular mobile microrganisms (with flagelle).

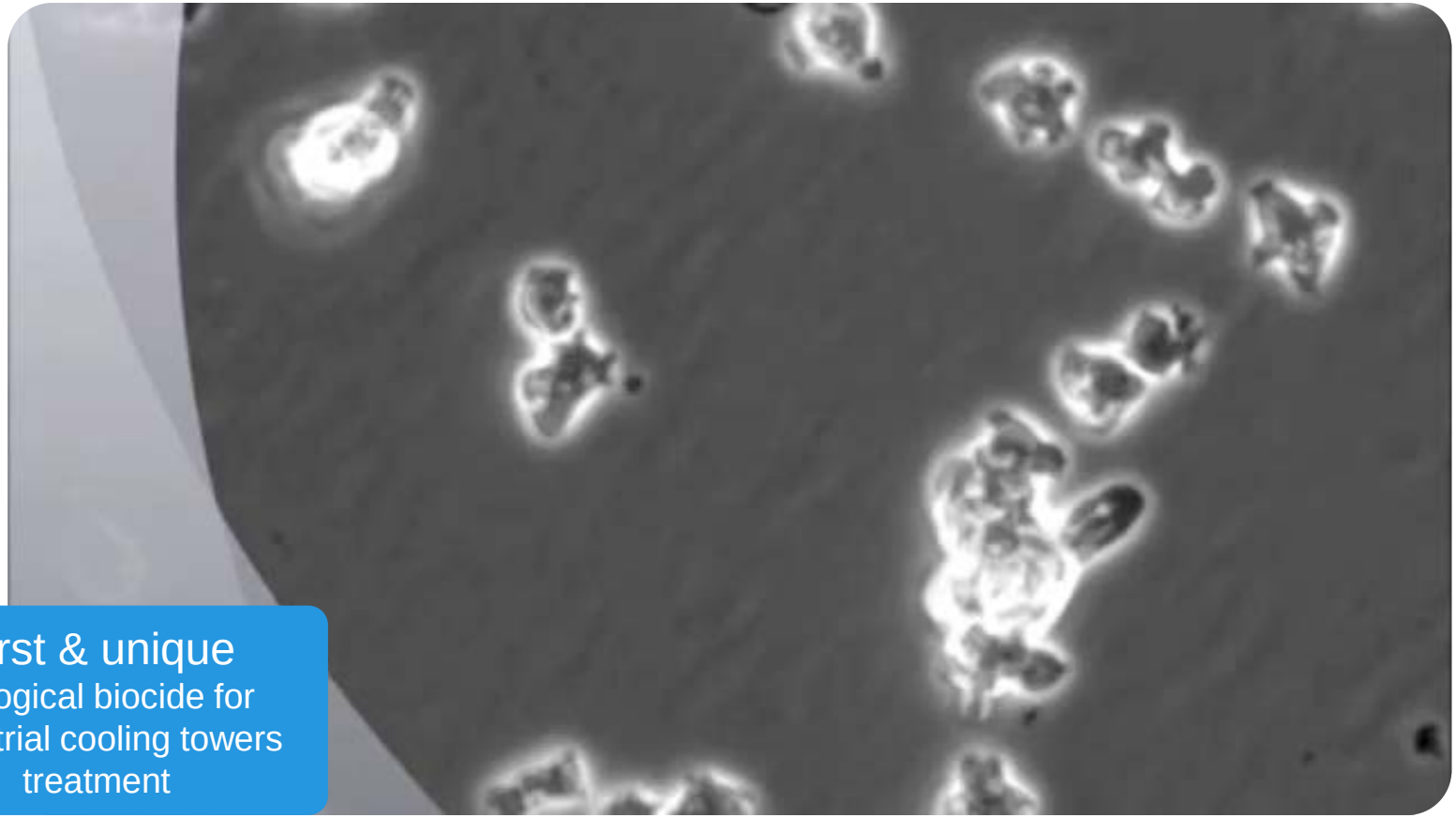
Different *Willaertia magna* strains exist:

- only « *C2c maky* » strain has such properties

Amoéba's disruptive technology

Willaertia magna C2c Maky:

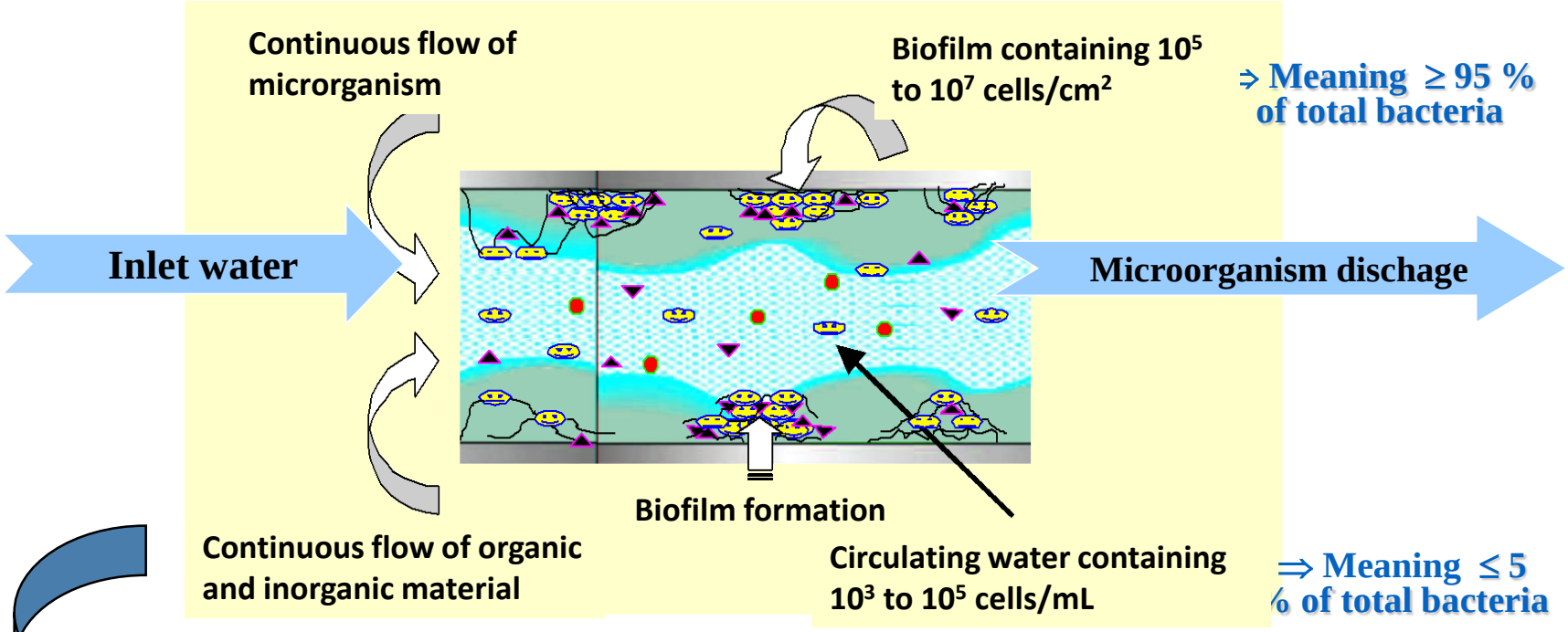
- A natural predator of bacteria, including *Legionella,* and other smaller amoebas



First & unique
biological biocide for industrial cooling towers treatment

Amoéba's disruptive technology ; about Biofilm

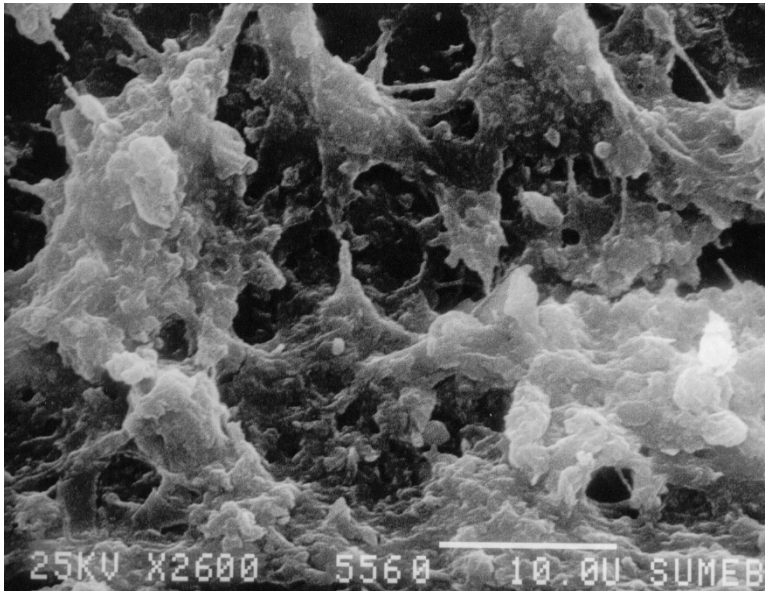
Biofilm buidup on circuit surfaces



Biofilm buidup speed up with :

- **higher temperature : 77 à 108°F in cooling tower circuits**
- **presence of nutriments : - organic : biodegradable material**
  - inorganics : Fe, Ca, ...

The « Biofilm » challenge



Matrix function :

- **structural**
  (Sutherland et al., 2001)
- **nutritive**
  (Gagnon et Huck, 2001)
- **protective**
  (Allison et al., 2000)

- **Microbial risks** in water systems
  = pathogen bacteria development and presence
- **Challenging Disinfection**
  - **Resistance mechanism from active bacteria (*Gilbert et al., 2003)***
  - **Higher consumtion of disinfectant because of a limited efficacy of chemical biocides (*Kiéné et Lévi, 2002*)**

Efficacy of Amoéba's biopesticide program:

A Representative results from Illinois cooling tower used for plastic molding

BIOMEBA industrial Tests in USA

amoéba

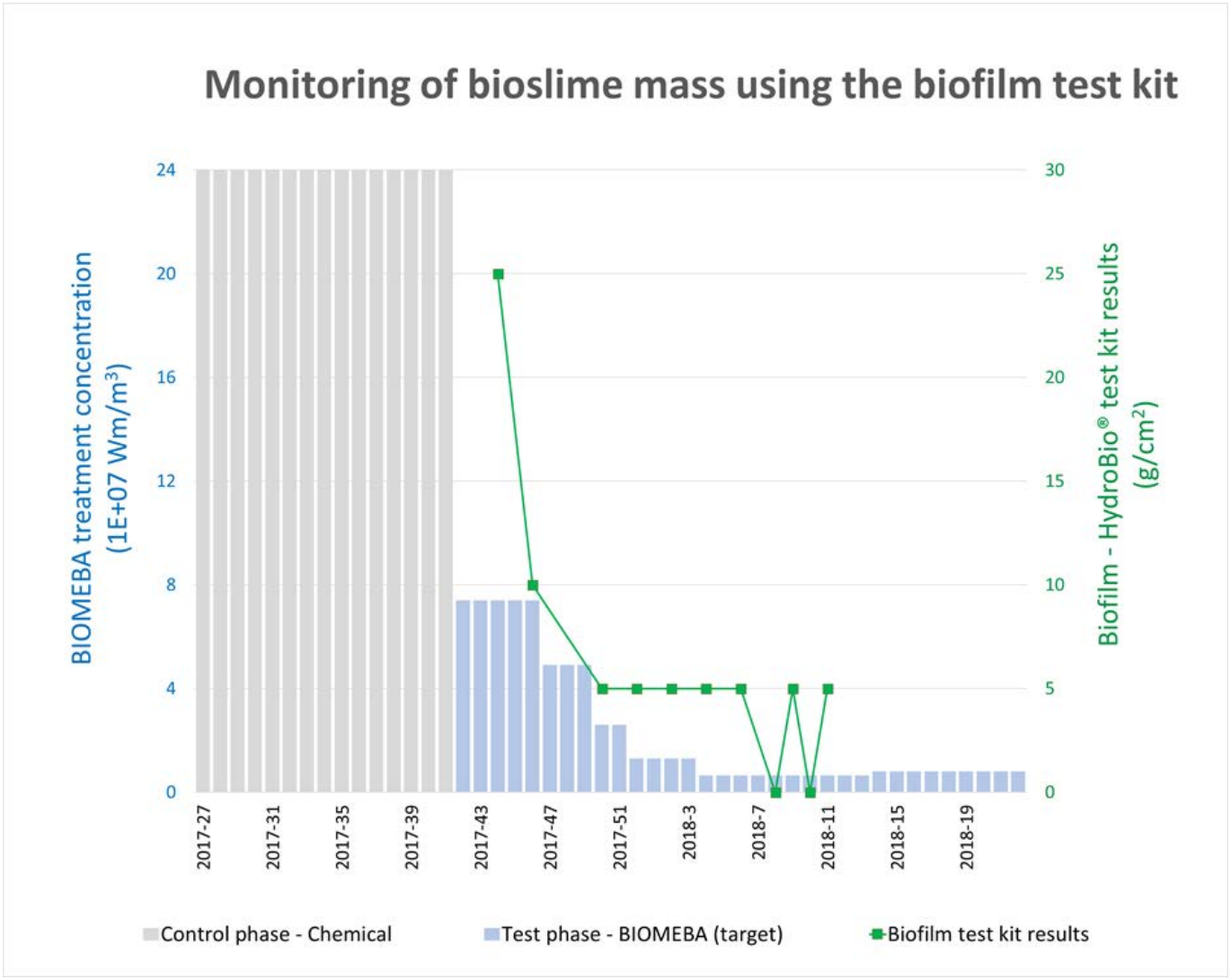
Test in Illinois,at a Plastic Extruder (food-grade plastic Cutlery and Cups production)

- **Circuit Characteristics** :
  - Industrial Cooling Towers (2) , semi-open , induced air
  - Cooling Tower Power = 600 Tons (~2000 kWatts)
  - MU = 29,000 Gallons/day (~110 m3/day)
    - Municipal potable water from Lake Michigan
    - Microbial quality assessed with no significant bacterial contamination
- **Test duration** : 8 months (from Oct 2017 to end of May 2018)

- **Biomeba Dosage**
  - Colonization phase = 7.4 ppm WM for 1 month
  - Intermediate dosage = 2.6 ppm WM for 1 month
  - Routine dosage=0.7 +/-0,1 ppm WM = >0.9 oz.fl /1000 Gal.(7 ml/m3) of 10% conc. Biomeba

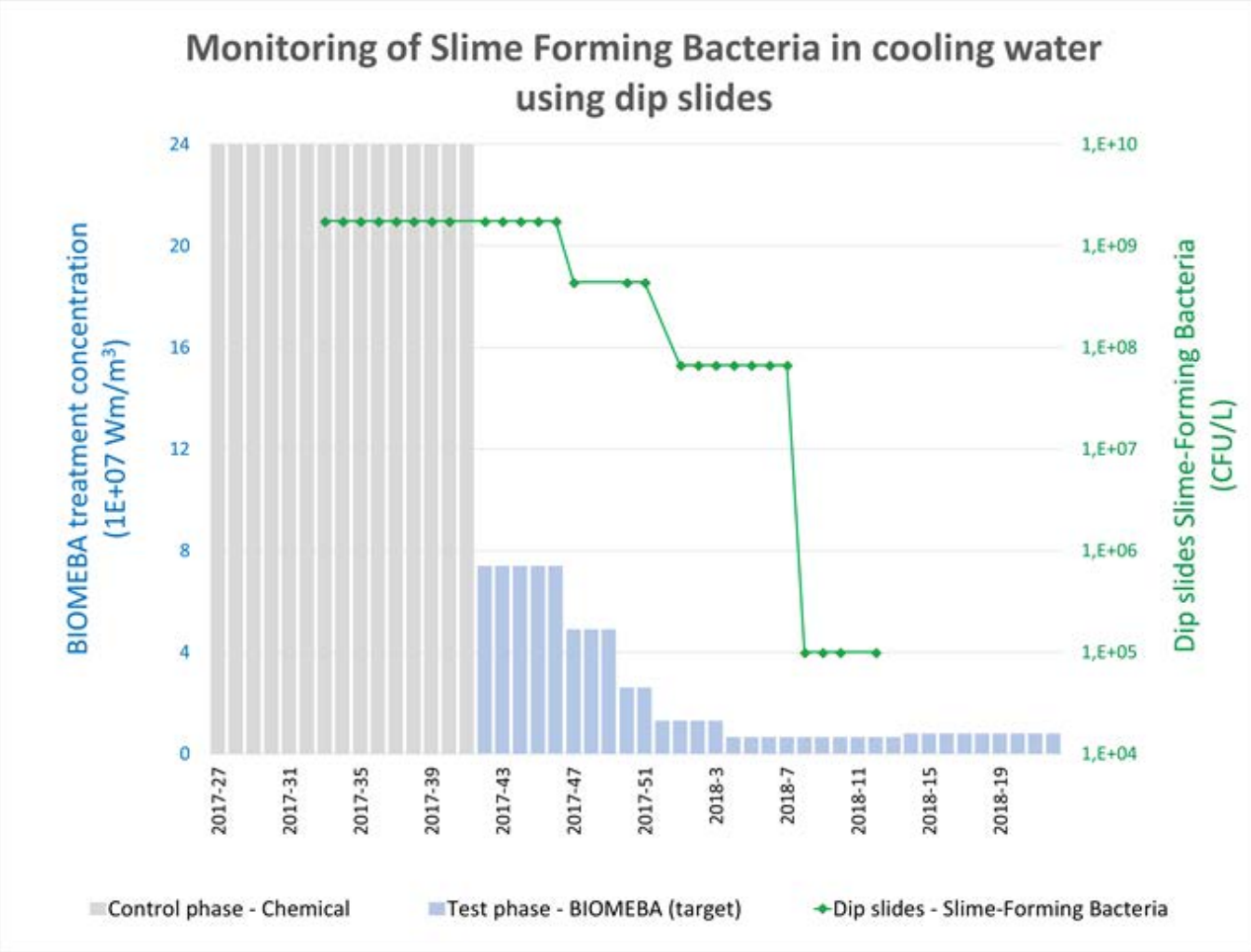
Amoéba's industrial tests in USA

Results on bioslime



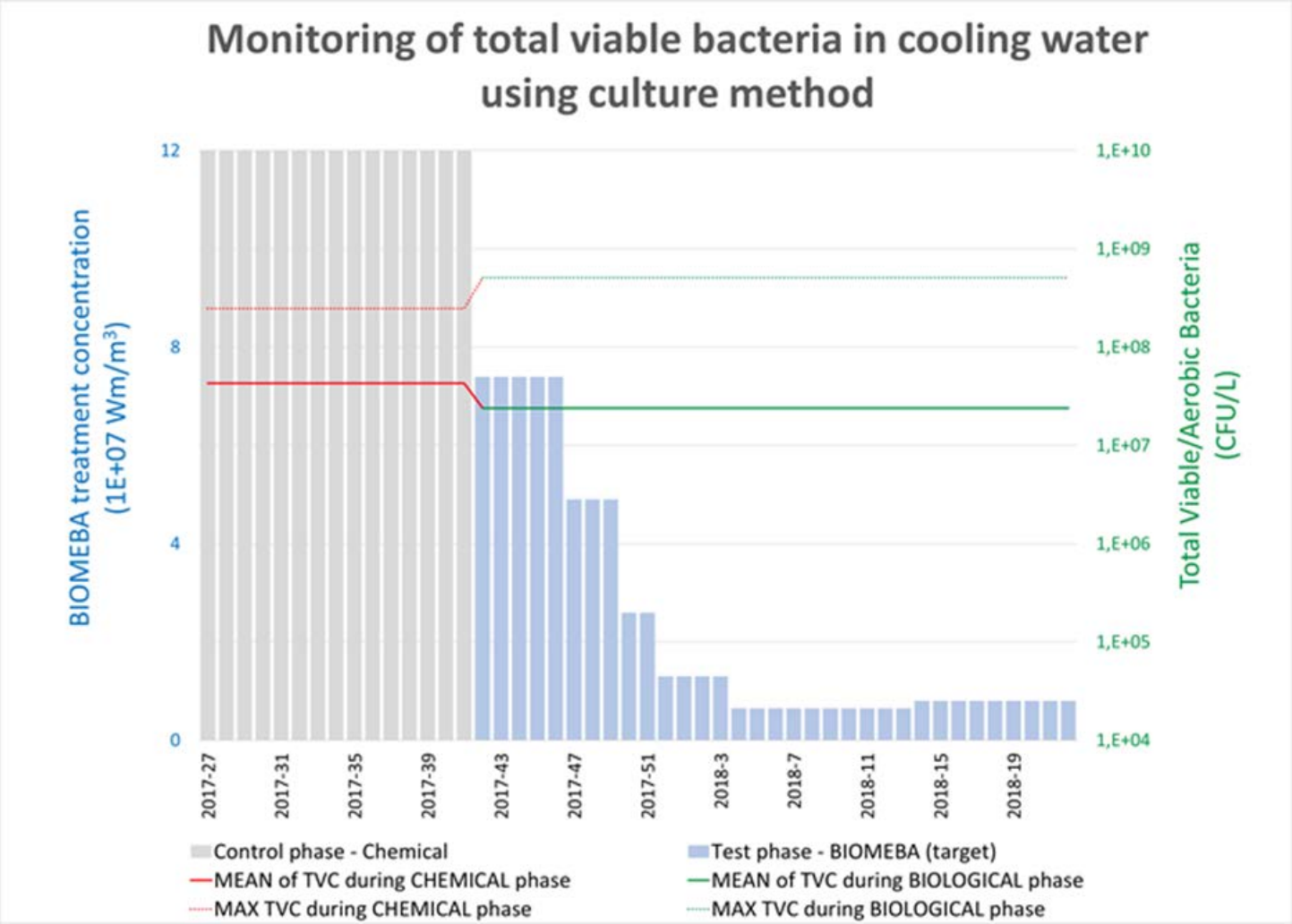
Amoéba's industrial tests in USA

Results on Slime forming bacteria



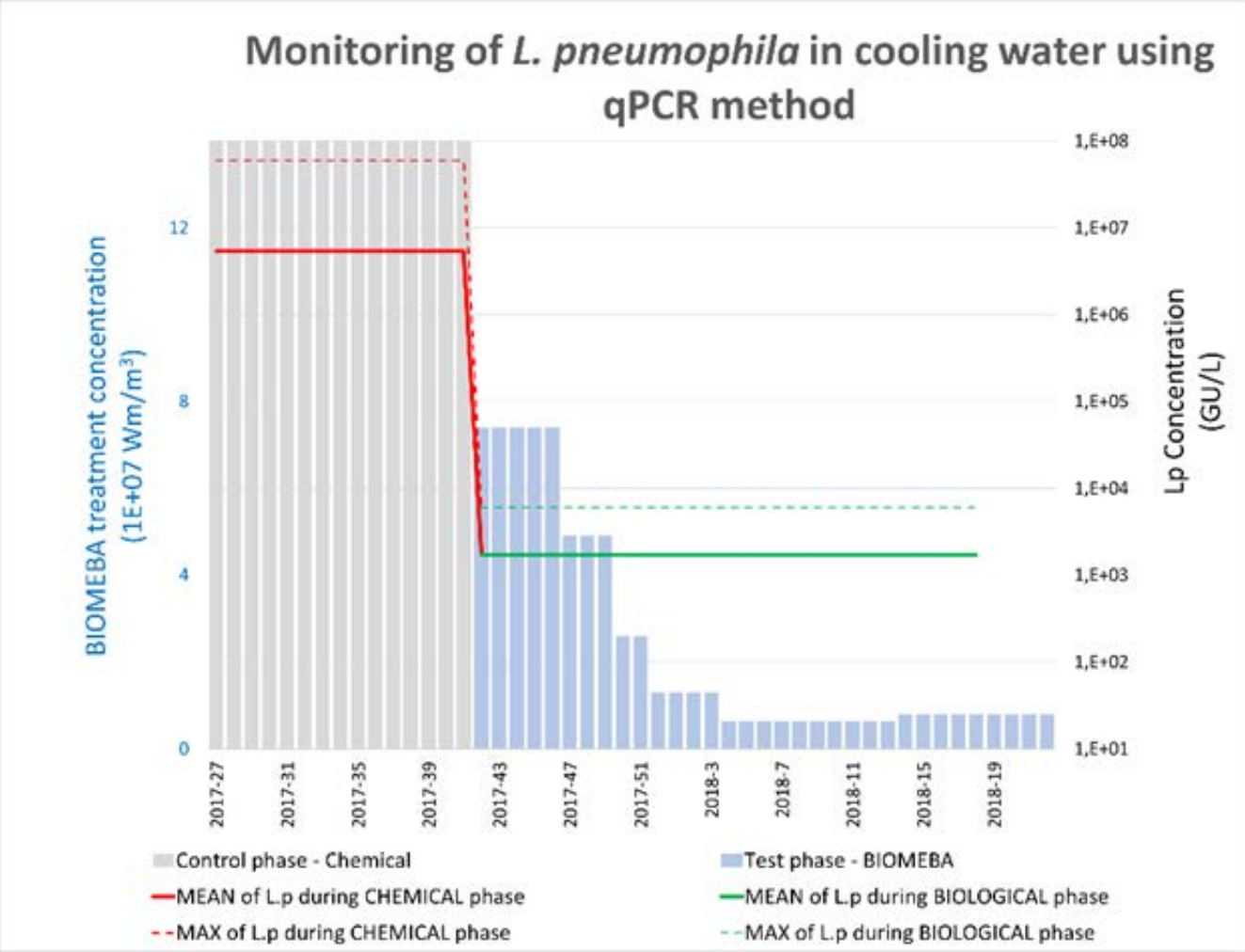
Amoéba's industrial tests in USA

Results on total viable bacteria



Amoéba's industrial tests in USA

Results on *Legionella pneumophila* (measurement by qPCR)



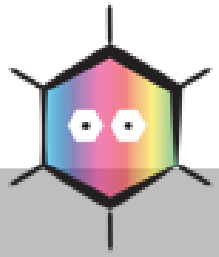
Amoéba's disruptive technology

And a capital difference with chemical biocides…

Amoéba's biopesticide

Efficient in water and in the biofilm

95% of the bacterial risk comes from the Biofilm



chemical biocides

Inefficient on the biofilm

Chemical treatments kills only bacteria into the water phase => **5%** of the risk

Amoéba's biopesticide: powerful, effective to control microorganisms in water & the biofilm

**Dalkia Study - June 2008: 99.5% of Legionella are found in biofilms*

Amoéba's disruptive technology

- A proven technology tested on real industrial sites in North America & Europe

Business sector		Number of tests
	Food industry	4
	Chemistry	5
	Heavy industry	4
	Commercial building	6
	Automotive	1
	Aviation	2
	Pharmaceutical	2
	Electronic	1
	Plastic industry	1

Some examples: Häagen-Dazs *(part of General Mills)* & ArcelorMittal

10 cumulated years of conclusive field trials on 31 end users' sites

Amoéba's industrial tests abroad

Examples of corrosion reduction with *Willaertia magna C2c* Maky vs chlorine

International Airport trial

Corrosion indicators	% of reduction vs oxydising biocide Program
Steel corrater measurement	**- 87 %**
Copper corrater measurement	**- 84 %**

ArcelorMittal

Corrater Amoeba CT: 0.6um
Corrater competitor CT: 2.5 um

=> 4 times less corrosion with *Willaertia magna C2C Maky*

Amoéba's disruptive technology

- Less carbon footprint

Amoéba's biopesticide

2.6 or 5.2 gallons

Easy to handle packaging

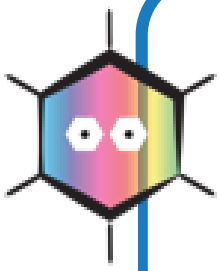
100% **recyclable**

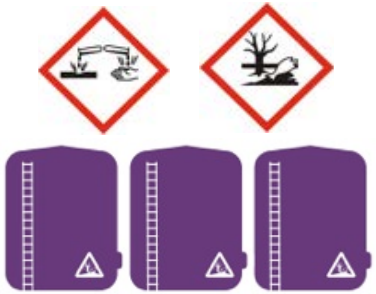
VS

Transport

Higher volumes , Large storage place

PPE





PLUG & PLAY Technology

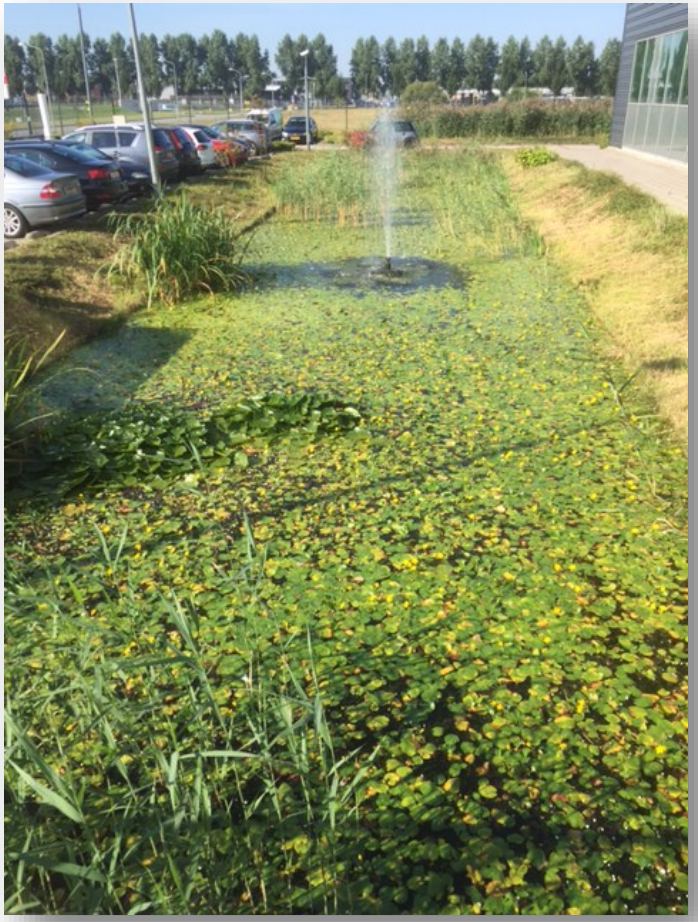
Positive environmental impact with Amoéba

Clean discharge for environment

Recreation basin collecting the blow-down of a cooling tower treated with

chemical biocides

Willaertia magna C2c Maky



Willaertia magna C2c Maky application

Biopesticide application procedures

- *Willaertia Magna C2c Maky* preferred life conditions:

Hardness	**some ppm Ca improves *Willaertia magna C2c M*aky's metabolism**
Optimal temperature	55 to 125 °F (25° to 45 °C)
Salinity resistance	0 to 9% (doesn't perform in sea water)
pH	from 5 to 10
Resistance to chlorine	up to 3.5 ppm free Cl_2 (7 ppm monochloramine)
Resistance to non oxidizing biocides	<0.1 ppm
Compatibility with anti-scalant & anti-corrosion programs	generally does not cause any problem but has to be validated by Amoeba

Conclusions

Conclusions

- *Willaertia magna C2c* Maky is a true green program:

1	100% organic	100% degradability in less than a week
2	100% biodegradable	No release of toxic residues in the environment
3	No residues	Easier procedures to get Waste Water discharge permit

Conclusions

- *Willaertia Magna C2c Maky* efficiency vs risk

- Active on bacteria planktonic form
- Active on bacteria sessile form
- Active into bioslime
- Active on other free living amoebas

↑Efficiency

- Clean environnemental discharge
- Lower carbon footprint
- No human toxicity
- No Eco-toxicity
- No pathogenicity

↓Environmental impacts

↓Risk

Conclusions

The active component *Willaertia magna C2c Maky* is:

- the first and unique green biocide to control bacteria and bioslime risks in cooling water systems. It can be applied without any investments and gives an ecological answer to water treatment.

This treatment program avoids chemical biocide discharge in the environment

Contact information

Jessyka Fortin & Claude Digiaro

jessyka.fortin@amoeba-biocide.com
claude.digiaro@amoeba-biocide.com

+1 (514 849 7600)

www.amoeba-biocide.com